"No individual in the United States shall, on the grounds of race, color, religion, sex, national origin, age, disability, political affiliation or belief, be excluded from participation in, or denied the benefits of, or be subjected to discrimination under any program or activity under the jurisdiction of the Kentucky Labor Cabinet."

FOREWORD

The material contained in this pamphlet is taken from 29 Code of Federal Regulations (CFR) 1910, Subparts "E" and "L", of the Kentucky Occupational Safety and Health Standards for General Industry as adopted by the Kentucky Occupational Safety and Health Standards Board.

Essentially, this pamphlet highlights the requirements for providing safe means of egress from fire and other emergencies (Subpart "E") and for portable fire protection equipment, fixed fire protection systems and fire brigades ("Subpart "L"). Its purpose is to help employers and employees recognize their responsibilities and the safety requirements in these particular areas. It should be emphasized that this pamphlet is only a guide to hazard recognition, and compliance with the requirements listed here does not necessarily assure full compliance with all Kentucky occupational safety and health standards. Should you have additional questions on the subjects covered in this pamphlet, please address them to one of the offices listed on the back cover of this booklet.

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1910.36 - GENERAL REQUIREMENTS FOR MEANS OF EGRESS

1910.36(a) This subpart contains general fundamental requirements essential to providing a safe means of egress from fire and like emergencies. Nothing in this subpart shall be construed to prohibit a better type of building construction, more exits or otherwise safer conditions than the minimum requirements specified for this subpart. Exits from vehicles, vessels or other mobile structures are not covered by this subpart.

1910.36(b)(3) Every building or structure shall be provided with exits of kinds, numbers, location, and capacity appropriate to the individual building or structure, with due regard to the character of the occupancy, the number of persons exposed, the fire protection available, and the height and type of construction of the building or structure, to afford all occupants convenient facilities for escape.

NOTE: Requirements prescribed in NFPA 101, Life Safety Codes.

1910.36(b)(4) In every building or structure, exits shall be so arranged and maintained as to provide free and unobstructed egress from all parts of the building or structure at all times when it is occupied. No lock or fastening to prevent free escape from the inside of any building shall be installed except in mental, penal, or corrective institutions where supervisory personnel are continually on duty and effective provisions are made to remove occupants in case of fire or other emergency.

1910.36(d)(1) Every required exit, way of approach thereto, and way of travel from the exit into the street or open space, shall be continuously maintained free of all obstructions or impediments to full instant use in the case of fire or other emergency.

1910.36(d)(2) Every automatic sprinkler system, fire detection and alarm system, exit lighting, fire door, and other items of equipment, where provided, shall be continuously in proper operating condition.

1910.37 - MEANS OF EGRESS STANDARDS

1910.37(a) Exits shall consist only of the approved components.

1910.37(a) Exits shall be constructed as part of the building or be permanently attached to it.

1910.37(b)(1) When an exit is protected by separation (for example, firewall) in buildings of three or less stories, the separation construction shall have a fire resistance rating of not less than one hour.

1910.37(b)(2) In buildings of four or more stories, the fire rating shall be not less than two hours.

1910.37(b)(3) Any opening must be protected with an approved self-closing door.

1910.37(b)(4) Openings in exit enclosures must be confined to those necessary for access to the enclosure for normally occupied spaces, and for egress at the discharge area.

1910.37(c)(2)&(3) A means of egress is measured in units of exit width (22 inches per unit) with each additional 12 inches equal to one-half unit. Units of exit widths are measured at the narrowest point. Exits or exit access doors must not restrict the width at any point during its swing.

1910.37(d)(1) The capacity of means of egress must be sufficient to accommodate the maximum number of persons that may be in the space at any time.

1910.37(d)(2) Where exits serve more than one floor, only the occupants of each floor need be considered, provided the exit capacity is not decreased in the direction of exit travel.

1910.37(e) Where more than one exit is required, the exits must be arranged to minimize the possibility that they could be blocked by a fire or other emergency condition.

1910.37(f)(1) Exit access shall be arranged to provide every occupant a convenient access to at least two exits by separate way of travel, and shall be readily accessible at all times.

NOTE: (1) At least two (2) exits remote from each other are recommended in every location of the workplace where feasible.

(2) At least two (2) exits remote from each other are required when an area is classified as "high hazard area."

(3) At least two (2) exits remote from each other are required where 50 or more employees work in an area

regardless of hazard classification.

1910.37(f)(2)	Exit doors must be side-hinged and must open in the direction of exit traffic when the room is occupied by more than 50 persons or used for high hazard occupancy.
1910.37(f)(3)&(4)	Exit access must not be through bathrooms or other rooms subject to locking. Hangings, draperies, or mirrors that would confuse occupants as to the direction of exits must not be placed on or near exit doors.
1910.37(f)(6)	The minimum width of any way of exit access is 28 inches.
	(*NOTE: More recent editions of NFPA 101 may require greater exit access width e.g. 32", 44", or 48", etc. depending on occupancy classification, aggregate capacity, new or existing occupancy determinations and wheelchair accommodations, etc.) The Americans with Disabilities Act may also have requirements that should be consulted.
1910.37(g)(1),(3)&(5)&(f)(1)	Exterior ways of access to exits may be by any exterior balcony, porch, gallery, or roof, but they must be protected from ice or snow. They must not have dead ends in access of 20 feet.
1910.37(h)(1)	Exits must discharge directly to the street or to a yard or court with access to the public way.
1910.37(h)(2)	Exit stairs that continue beyond the floor on which occupants leave the building must be interrupted at that floor by a partition or door.
1910.37(i)	Head room requirements: ceiling height not less than 7 feet, 6 inches; projections from the ceiling not less than 6 feet, 8 inches from the floor.
1910.37(j)	Where a means of egress is not substantially level, such difference in elevation shall be negotiated by stairs or ramps.
1910.37(k)(1)	All components of means of egress must be of substantial and reliable construction and be installed in a workmanlike manner.
1910.37(k)(2)	Means of egress shall be continuously maintained free of all obstructions or impediments to full instant use in the case of fire or other emergency.
1910.37(l)(1)	Furnishings or decorations must not obstruct exits, access of exits, or visibility of exits.
1910.37(l)(2)	No furnishings or decorations of an explosive or highly flammable character shall be used in any occupancy.
1910.37(q)(1)	Exits and access to exits must be identified by readily visible signs.
1910.37(q)(2)	Doors or stairways that could be mistaken as exits must be identified with signs as to their actual character, such as "TO BASEMENT," "STOREROOM," "LINEN CLOSET," etc.

1910.37(q)(4) Every exit sign must be distinctive in color, contrasting with other signs or decorations.

1910.37(q)(5) A sign reading "Exit," or similar designation, with an arrow indicating the direction, shall be placed in every location where the direction of travel to reach the nearest exit is not immediately apparent.

1910.37(q)(6)&(7) Every exit sign must be illuminated by a reliable light source, and internally illuminated exit signs must be provided where reduction of normal illumination is permitted.

1910.37(q)(8) Letters on exit signs must not be less than six inches high with letter strokes at least three-fourths of an inch wide.

These standards were originally developed and published by the National Fire Protection Association (NFPA) as "Life Safety Code" (101). Copies of the Code may be obtained from NFPA, One Batterymarch Park, P.O. Box 9101, Quincy, Massachusetts, 02269-9101.

1910.38 - EMPLOYEE EMERGENCY PLANS AND FIRE PREVENTION PLANS

This section applies to all emergency action plans which may be required by a particular OSH standard. However, the section does not, by itself, require the employer to establish an emergency action plan. The section contains only the criteria to be followed in establishing emergency plans which are or which will be required by other specific OSH standards. For example, an employer can obtain certain exemptions from the requirements of 1910.157, Portable Fire Extinguishers, if an emergency action plan is established in accordance with the requirements of this section. Further, in paragraph 1910.160(c)(1), the employer is required to provide an emergency action plan in accordance with 1910.38 for areas where total flooding fire extinguisher systems use agent concentrations exceeding maximum safe levels.

(*NOTE: Employers who choose to evacuate employees or who may reasonably anticipate having to evacuate employees, due to 1910.1200 or 1910.120 chemical spills, must also comply with these requirements.)

DEFINITIONS

Emergency Action Plan -- A plan for a workplace, or parts thereof, describing what procedures the employer and employees must take to ensure employee safety from fire or other emergencies.

Fire Prevention Plan -- Plans required if the employer chooses not to fight fires in their facility. These plans should include recognition and control of workplace hazards, control of ignition sources, proper housekeeping practices, and a roster of fire safety maintenance personnel.

Emergency Escape Route -- The route that employees are directed to follow in the event they are required to evacuate the workplace or seek a designated refuge area.

Fire Warden -- An employee designated to assist in the evacuation of employees from the workplace.

TYPES OF EMERGENCIES THAT NEED PLANS

(a) Fire and explosion

(b) Severe weather

(c) Hazardous materials spills and leaks

(d) Bomb threats

EMERGENCY ACTION PLANS

Emergency action plans shall be in writing and include, but not be limited to:

(a) Emergency escape procedures and emergency escape route assignments (map of plant).

(b) Procedures to be followed by employees who remain to operate and/or shut down critical plant operations before they evacuate.

(c) Procedures to account for all employees after emergency evacuation has been completed.

(d) Duties and responsibilities of personnel performing rescue and medical duties.

(e) The preferred means of reporting fires and other emergencies.

(f) Description of expected emergencies, their hazards and plan of action to combat the emergencies.

(g) Names or regular job titles of persons or departments who can be contacted for further information or explanation of duties under the plan.

(h) An alarm system which complies with 1910.165.

(i) The plan shall establish the types of evacuation to be used in emergency circumstances.

(j) Provide training for designated fire wardens initially when plan is established, when job assignments under the plan change, and when the plan itself changes or at least quarterly.

(k) Provide training in the implementation of the plan to all employees, initially, when there is a change of job responsibilities and whenever the plan is changed.

(l) The plan must be in writing, kept at the workplace, and made available for employees' review. For those employers with 10 or fewer employees, the plan may be communicated orally and the employer need not maintain a written plan.

NOTE: The employer shall review with each employee upon initial assignment, those parts of the plan which they must know to protect themselves in the event of an emergency.

FIRE PREVENTION PLANS

The fire prevention plan shall be in writing and include, but not be limited to:

(a) A list of major workplace fire hazards.

(b) Proper handling and storage procedures.

(c) Potential ignition sources (welding, smoking, etc.) and their control procedures.

(d) Type of fire protection equipment or systems needed to control a fire involving the fire hazards.

(e) Names of personnel responsible for the maintenance of fire protection equipment and systems.

(f) Names of personnel responsible for control of fuel source hazards.

(g) Procedures for controlling accumulations of flammable and combustible waste and for housekeeping.

PART II - FIRE PROTECTION

Subpart "L"
(1910.155 thru 1910.165)

On January 7, 1981, the Kentucky Occupational Safety and Health Program adopted revisions of safety standards for fire protection. A significant change within the realm of fire protection standards was the introduction of the "performance" standard, which provides employers with options and flexibility in meeting their particular needs for fire protection.

This booklet contains both performance and specification standards in addition to supplemental information, and is designed to provide the reader with a basic understanding of the requirements for fire protection. Various sections of the standards have been rearranged in an effort to categorize the subject matter.

MANAGEMENT DECISIONS

The employer's selection of a course of action regarding employee and fire protection depends on both the requirements and the needs of each individual employer. This decision is usually made by top management and requires careful consideration. The most important factors in providing adequate safety in a fire situation are the availability of proper exit facilities to assure ready access to safe areas, and the proper education of employees as to the actions to be taken in a fire emergency.

There are two basic options available to the employer:

Option A: Employees will fight fires.

Option B: Employees will not fight fires.

Once the employer has decided which option to take, he or she must comply with the specific criteria pertaining to that option. These criteria are outlined in the charts on the next two pages. Applicable standard numbers are included for easy reference.

Figure 2.1
Option (a): Will Fight Fires

Figure 2.2
Option (b): Will Not Fight Fires

1910.157 - PORTABLE FIRE EXTINGUISHERS

DEFINITIONS

Approved - acceptable to the Secretary of Labor under the following criteria:

(a) If it is accepted, or certified, or listed, or labeled or otherwise determined to be safe by a nationally recognized testing laboratory, such as, but not limited to, Underwriters' Laboratories, Inc. or the Factory Mutual System; or

(b) With respect to an installation of equipment of a kind which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, if it is inspected or tested by another Federal/State agency and found in compliance with the provisions of applicable National Fire Protection Association Fire Code; or

(c) With respect to custom-made equipment or related installations which are designed, fabricated for, and intended for use by the manufacturer on the basis of test data which the employer keeps and makes available for inspection to the Secretary of Labor.

Inspection - A visual check of fire protection systems and equipment to ensure that they are in place, charged, and ready for use in the event of a fire.

Extinguishers Classification - The letter classification given an extinguisher to designate the class or classes of fire on which an extinguisher will be effective.

Extinguisher Rating - The numerical rating given to an extinguisher which indicates the extinguishing potential of the unit based on standardized tests developed by Underwriters' Laboratories, Inc.

This A-B-C extinguisher has a U.L. classification of 2A 10-B:C.

GENERAL REQUIREMENTS

The scope and application of this section is written to apply to three basic types of workplaces. First, there are those workplaces where the employer has chosen to evacuate all employees from the workplace at the time of a fire emergency. Second, there are those workplaces where the employer has chosen to permit certain employees to fight fires and to evacuate all other non-essential employees at the time of a fire emergency. Third, there are those workplaces where the employer has chosen to permit all employees in the workplace to use portable fire extinguishers to fight fires.

This section also addresses two kinds of work areas. The entire workplace can be divided into outside (exterior) work areas and inside (interior) work areas. This division of the

workplace into two areas is done in recognition of the different types of hazards employees may be exposed to during fire fighting operations. Fires in interior workplaces, pose a greater hazard to employees; they can produce greater exposure to quantities of smoke, toxic gases, and heat because of the capability of a building or structure to contain or entrap these products of combustion until the building can be ventilated. Exterior work areas, normally open to the environment, are somewhat less hazardous, because the products of combustion are generally carried away by the thermal column of the fire. Employees also have a greater selection of evacuation routes if it is necessary to abandon fire fighting efforts.

In recognition of the degree of hazard present in the two types of work areas, the standards for exterior work areas are somewhat less restrictive in regards to extinguisher distribution. Paragraph (a) explains this by specifying which paragraphs in the section apply.

1910.157(a) The requirements of this section apply to the placement, use, maintenance, and testing of portable fire extinguishers provided for the use of employees. 1910.157(d) does not apply to extinguishers provided for employee use on the outside of workplace buildings or structures. Where extinguishers are provided but are not intended for employee use and the employer has an emergency action plan and a fire prevention plan which meet the requirements of 1910.38, then only the requirements of 1910.157(e) and (f) apply.

NOTE: In recognition of the three options given to employers in regard to the amount of employee evacuation to be carried out, the standards permit certain exemptions based on the number of employees expected to use fire extinguishers.

Where the employer has chosen to totally evacuate the workplace at the time of a fire emergency and when fire extinguishers are not provided, the requirements of this section do not apply to that workplace.

Where the employer has chosen to partially evacuate the workplace or the affected area at the time of a fire emergency and has permitted certain designated employees to remain behind to operate critical plant operations or to fight fires with extinguishers, then the employer is exempt from the distribution requirements of this section. Employees who will be remaining behind to perform incipient fire fighting or members of a fire brigade must be trained in their duties. The training must result in the employees becoming familiar with the locations of fire extinguishers. Therefore, the employer must locate the extinguishers in convenient locations where the employees know they can be found.

For example, they could be mounted in the fire truck or cart that the fire brigade uses when it responds to a fire emergency. They can also be distributed as set forth in the National Fire Protection Association's Standard No. 10 "Portable Fire Extinguishers."

Where the employer has decided to permit all employees in the workforce to use fire extinguishers, then the entire OSH standard, 1910.157, applies.

1910.157(b) (1) Where the employer has established and implemented a written fire safety policy which requires the immediate and total evacuation of employees from the workplace upon the sounding of a fire alarm signal and which includes an emergency plan and a fire prevention plan which meets the requirements of 1910.38, and when extinguishers are not available in the workplace, the

employer is exempt from all requirements of this section unless a specific standard in Part 1910 requires that a portable fire extinguisher be provided.

(2) Where the employer has an emergency action plan meeting the requirements of 1910.38 which designates certain employees to be the only employees authorized to use the available portable fire extinguishers, and which requires all other employees in the fire area to immediately evacuate the affected work area upon the sounding of the fire alarm, the employer is exempt from the distribution requirements in 1910.157 of this section.

1910.157(c) (1) The employer shall provide portable fire extinguishers and shall mount, locate and identify them so that they are readily accessible to employees without subjecting the employees to possible injury.

(2) Only approved portable fire extinguishers shall be used to meet the requirements of this section.

(3) The employer **shall not** provide or make available in the workplace portable fire extinguishers using carbon tetrachloride or chlorobromo-methane extinguishing agents. **NOTE: Carbon tetrachloride releases a highly toxic gas when used on a fire.**

(4) The employer shall assure that portable fire extinguishers are maintained in a fully charged and operable condition and kept in their designated places at all times except during use.

1910.157(c)(5) The employer shall permanently remove from service by January 1, 1982, all soldered or riveted shell self-generating soda acid or self-generating foam or gas cartridge water type portable fire extinguishers which are operated by inverting the extinguisher to rupture the cartridge or to initiate an uncontrollable pressure generating chemical reaction to expel the agent.

NOTE: American manufacturers stopped making the inverting-type extinguishers in 1969. The types include soda-acid, foam, and cartridge-operated water and loaded stream extinguishers. However, many of these types are still in use and should be removed from service. They are dangerous from the standpoint that if the discharge hose is blocked these extinguishers can build up excess pressure and explode, causing serious injury and/or death.

1910.157(d)(1) Portable fire extinguishers shall be provided for employee use and selected and distributed based on the classes of anticipated workplace fires and on the size and degree of hazard which would affect their use.

NOTE: The employer is responsible for the proper selection and distribution of fire extinguishers and the determination of the necessary degree of protection. The selection and distribution of fire extinguishers must reflect the type and class of fire hazards associated with a particular workplace. Different types of fire extinguishers are designed to extinguish fires involving different types of fuel. Extinguishers are classified as A, B, C, or D (or a combination) depending on the fire against which their agents are effective.

"Class A fire" means a fire involving ordinary combustible materials such as paper, wood, cloth, and some rubber and plastic materials.

"Class B fire" means a fire involving flammable or combustible liquids, flammable gases, greases and similar materials, and some rubber and plastic materials.

"Class C fire" means a fire involving energized electrical equipment where safety to the employee requires the use of electrically nonconductive extinguishing media.

"Class D fire" means a fire involving combustible metals such as magnesium, titanium, zirconium, sodium, lithium, and potassium.

NOTE: The effectiveness of an extinguisher on a particular fire depends on the amount and type of agent in the extinguisher. Different extinguishing agents can be used to put out a certain class of fire by one or more methods: removing oxygen, heat, fuel, and interrupting the chemical chain reaction. Some extinguishing agents may be able to extinguish more than one class of fire. They are marked with multiple letters (A, B, C) or symbols and number ratings.

The following are the most common extinguishing agents, the classes of fire they are used against, and the extinguishing methods they use:

Water - Used only on Class A fires. Water is most effective in cooling the burning material below its ignition temperature. Under certain conditions, the steam converted from the water will exclude oxygen and smother the fire.

Foam - Used only on Class A and B fires. Foam removes fuel by forming a layer over a burning liquid and preventing flammable vapors from escaping. Foam will also smother by keeping oxygen from mixing with the vapors and cool with a constant layer of water-bearing foam.

Dry Chemicals - There are two basic types of dry chemical extinguishing agents: regular or ordinary dry chemicals used only on Class B or C fires, and multi-purpose dry chemicals used on Class A, B, and C fires. Dry chemical agents inhibit the chain reaction and, to a certain degree, cool and smother the fire.

Carbon Dioxide (CO_2) - Used on Class B and C fires. CO_2 extinguishes fire by smothering, reducing the oxygen level below that which supports combustion. Under certain conditions, the cooling effect of the gas also helps put out the fire. (-110^0)

Halons - Used on Class B and C fires. These liquefied gases are most effective in interrupting the chain reaction, but they also have slight smothering and cooling effects. Halon 1301, Bromotrifluoromethane, is an example.

1910.157(d)

(2) The employer shall distribute portable fire extinguishers for use by employees on **Class A** fires so that the travel distance for employees to any extinguishers is never more than **75 feet** (22.9 m).

(3) The employer may use uniformly spaced standpipe systems or hose stations connected to a sprinkler system installed for emergency use by employees instead of **Class A** portable fire extinguishers, provided that such systems meet the respective requirements of 1910.158 or 1910.159, that they provide total coverage of the area to be protected, and that employees are trained at least annually in their use.

(4) The employer shall distribute portable fire extinguishers for use by employees on **Class B** fires so that the travel distance from the Class B hazard area to any extinguisher is never more than **50 feet** (15.2 m).

(5) The employer shall distribute portable fire extinguishers used for **Class C** hazards on the basis of the appropriate pattern for the existing Class A or Class B hazards.

(6) The employer shall distribute portable fire extinguishers or other containers of **Class D** extinguishing agent for use by employees so that the travel distance from the combustible metal working area to any extinguishing agent is never more than **75 feet** (22.9 m). Portable fire

extinguishers for Class D hazards are required in those combustible metal working areas where combustible metal powders, flakes, shavings, or similarly sized products are generated at least once every two weeks.

NOTE: The ultimate responsibility for the inspection, maintenance and testing of portable fire extinguishers lies with the employer. The actual inspection, maintenance, and testing required by these standards may, however, be conducted by properly qualified outside contractors with whom the employer has arranged to do the work.

If the employer should elect to perform the inspection, maintenance, and testing requirements of this section in-house, then the employer must make sure that those persons doing the work have been properly trained to do the work and to recognize problem areas which could cause an extinguisher to be

Advisory

Employers should establish a program for the periodic inspection of each extinguisher and an effective fire extinguisher maintenance program.

Two (2) main factors, which determine a fire extinguisher's worth, are its serviceability and its accessibility. Anytime the employer has removed an extinguisher from service to be checked or repaired, alternate equivalent protection must be provided. Alternate equivalent protection could include replacing the extinguisher with one or more units having equivalent or equal ratings, posting a fire watch, shutting off the unprotected area from employee exposure, or providing a hose system ready to operate.

The following items should be checked:

- Accessibility and proper location.
- Tag or record for date of last recharge inspection.
- Nozzle for obstructions and operation.
- Corrosion, leaks at seams, or mechanical damage.
- Lockpin and seal.
- Determine if full (water level, pressure gauge, or weight).
- Condition of hose and hose coupling.
- Horns for cracks, dirt, or grease accumulation.

Fire extinguisher maintenance, particularly hydrostatic testing, is a specialized activity and should be performed by competent persons. Fire extinguishers are provided to protect life and property and there should be no doubt as to their reliability in time of emergency.

Persons responsible for performing fire extinguisher maintenance may be trained industrial safety and maintenance personnel or extinguisher service companies. While some extinguisher owners may seek out and utilize the services provided by fire extinguisher maintenance firms, many large industries often find it desirable to train their own personnel to perform this function. **NOTE: Requirements for hydrostatic testing are listed in 1910.157(f).**

The employer may contract for hydrostatic testing. However, if the employer wishes to provide the testing service, certain equipment and facilities must be available. Employees should be made aware of the hazards associated with hydrostatic testing and the importance of using proper guards and water pressures. Severe injury can result if extinguisher shells fail violently under hydrostatic pressure.

Employers are encouraged to use contractors who can perform adequate and reliable service. Firms which have been certified by the Materials Transportation Board (MTB) of the U.S. Department of Transportation (DOT) or State licensed extinguisher servicing firms or those firms recognized by the National Association of Fire Equipment Distributors in Chicago, Illinois, are generally acceptable for performing this service.

inoperable. The National Fire Protection Association provides excellent guidelines in its standard for portable fire extinguishers. The employer may also check with the manufacturer of the unit that has been purchased and obtain guidelines on inspection, maintenance, and testing. **Hydrostatic testing is a process that should be left to contractors or individuals using suitable facilities and having the training necessary to perform the work.**

1910.157(e)

(1) The employer shall be responsible for the maintenance and testing of all portable fire extinguishers in the workplace.

(2) Portable extinguishers or hose used in lieu thereof under 1910.157(d)(3) of this section, shall be visually inspected monthly.

(3) The employer shall assure that portable fire extinguishers are subjected to an annual maintenance check. Stored pressure extinguishers do not require an internal examination. The employer shall record the annual maintenance date and retain this record for one year after the last entry or the life of the shell, whichever is less. The record shall be available to the Assistant Secretary upon request.

(4) The employer shall assure that stored pressure dry chemical extinguishers that require a 12-year hydrostatic test are subjected to applicable maintenance procedures every 6 years. Dry chemical extinguishers having non-refillable disposable containers are exempt from this requirement. When recharging or hydrostatic testing is performed, the 6-year requirement begins from that date.

Table L-1

Type of Extinguishers	Test Interval (years)
Soda acid (soldered brass shells)(until 1/1/82)	([1])
Soda acid (stainless steel shell)	5
Cartridge operated water and/or antifreeze	5
Stored pressure water and/or antifreeze	5
Wetting agent	5
Foam (soldered brass shell)(until 1/1/82)	([1])
Foam (stainless steel shell)	5
Aqueous Film Forming foam (AFFF)	5
Loaded stream	5
Dry chemical with stainless steel	5
Carbon dioxide	5
Dry chemical, stored pressure, with mild steel, brazed brass or aluminum shells	12
Dry chemical, cartridge or cylinder operated, with mild steel shells	12
Halon 1211	12
Halon 1301	12
Dry power, cartridge or cylinder operated with mild steel shell	12

[1]Extinguishers having shells constructed of copper or brass joined by soft solder or rivets shall not be hydrostatically tested and must have been removed from service by January 1, 1982.

Advisory

A fire extinguisher maintenance program should include the purchase and maintenance dates of all extinguishers. These dates may be on the extinguisher, but a separate record (log) is desirable including the following information.

(1) The maintenance date and name of person or agency performing the maintenance.

(2) The date when last recharged and the name of the person or agency performing recharge.

(3) The date when last hydrostatic test was conducted and the name of person or agency performing the test.

Training and Education

DEFINITIONS

Education - The process of imparting knowledge or skill through systematic instruction.

Training - The process of making proficient through inspection and **hands-on practice** in the operation of equipment.

Designated Employee - A person selected to handle small fires **in their own immediate work area.**

Incipient Stage Fire - A fire which is in the initial or beginning stage and which can be controlled or extinguished by portable fire extinguishers, Class II standpipe or small hose system **without the need for protective clothing and breathing apparatus.**

1910.157(g)

(1) Where the employer has provided portable fire extinguishers for employee use in the workplace, the employer shall also provide an educational program to familiarize employees with the general principles of fire extinguisher use and the hazards involved with incipient stage fire fighting.

NOTE: If an employer expects an employee to fight an incipient stage fire in *their* immediate work area, those employees are theoretically designated and should comply with 1910.157(g).

(2) The employer shall provide the education required in paragraph (g)(1) of this section upon initial employment and at least annually thereafter.

(3) The employer shall provide employees who have been designated to use fire fighting equipment as part of an emergency action plan with training in the use of the appropriate equipment.

(4) The employer shall provide the training required in paragraph (g)(3) of this section upon initial assignment to the designated group of employees and at least annually thereafter.

Advisory

Portable fire extinguishers offer the best protection for immediately controlling fires in the workplace. The portability and the easy operation makes them ready for use within seconds in case of a fire. Training and education is required and helps in proper use of the extinguisher. Employees should know how to identify extinguishers, types that are available, where they are located in the workplace, and how to use them properly.

Portable fire extinguishers come in many shapes, sizes, and types. Employers should choose the right size and type to meet their needs, based on the hazards present. Regardless of the manufacturer, the methods of operation of extinguishers are basically the same. The instructions are on the nameplate of the extinguisher. However, every employee should be familiar with the following general instructions which apply to most fire extinguishers, and with the more specific instructions of each type.

NOTE: Employees should be familiar with classes of fires and extinguishers. For example, an employee would *not* use a Class "A" portable fire extinguisher on a Class "C" fire, unless the extinguishers had an A-B-C rating.

Most portable fire extinguishers are designed to be carried and used in an upright position. Before using the extinguisher, an employee should be close enough for the agent of the extinguisher to reach the fire.

Operation of Hand-Held Portable Fire Extinguishers

There are **four basic steps** for using most hand-held portable fire extinguishers:

(1) Pull the pin (breaking the seal) at the top of the extinguisher.

(2) Point the nozzle or outlet toward the base of the fire. If the hose or horn is clipped to the body of the extinguisher, be sure to unclip it first.

(3) Press the handle above the carrying handle to discharge the agent. Release the handle to stop agent from being discharged.

(4) Sweep the hose or nozzle back and forth to spread agent on the fire. Direct agent to the base of the flames. **NOTE: Someone should make sure the fire is out by probing the smoldering spots or liquids that could reflash, before leaving area.**

NOTE: In the event of a fire, regardless of size, management and the proper authorities (local fire service) should be notified in conjunction with fire fighting activities. An initial plan should be a part of education and training, including replacement and recharging of portable fire extinguishers after use. This plan may include emergency evacuation of other work areas.

KEYNOTES: This part of the standard is of the utmost importance to employers and employees if the risk of injury or death due to extinguisher use is to be reduced. If an employer is going to permit an employee to fight a workplace fire of any size, the employer must make sure that the employee knows everything necessary to assure the employee's safety.

Training and education can be obtained through many channels. Often, local fire departments in larger cities have fire prevention bureaus or similar organizations which can provide basic fire prevention training programs. Fire insurance companies will have data and information available. The National Fire Protection Association and the National Safety Council will provide, at a small cost, publications that can be used in a fire prevention program.

Actual fire fighting training can be obtained from various sources in the country. The Texas A&M University, the University of Maryland's Fire and Rescue Institute, West Virginia University's Fire Service Extension, Iowa State University's Fire Service Extension and other State training schools and land grant colleges have fire fighting programs directed to industrial applications. Some manufacturers of extinguishers, such as the Ansul Company and Safety First, conduct fire schools for customers in the proper use of extinguishers. Several large corporations have taken time to develop their own on-site training programs which expose employees to the actual "feeling" of fire fighting. Simulated fires for training of employees in the proper use of extinguishers are also an acceptable part of a training program.

In meeting the requirements of this section, the employer may also provide educational materials, without classroom instruction, through the use of employee notice campaigns using instruction sheets or flyers of similar types of informal programs. The employer must make sure that employees are trained and educated to recognize not only what type of fire is being fought and how to fight it, but also when it is time to get away from it and leave fire suppression to more experienced fire fighters.

When extinguishers are provided and intended for employee use and the employer **does not** have an emergency action plan, a fire prevention plan or a written fire safety policy, then employees **must** be educated with the general principles of fire extinguisher use and the hazards involved with incipient stage fire fighting.

Employees should also receive hands-on training.

1910.156 - FIRE BRIGADES

DEFINITIONS

Incipient Stage Fire Brigade - An organized group of employees who are knowledgeable, trained and skilled in at least basic fire fighting operations and who collectively respond to any location to fight a fire in the initial stage which can be controlled or extinguished by Class II standpipe hose systems (1 1/2 inch) or portable fire extinguishers without the need for protective clothing or breathing apparatus.

Interior Structural Fire Brigade - An organized group of employees who are knowledgeable, trained and skilled in at least basic fire fighting operations and who collectively respond to any location to fight a fire and perform rescue operations inside building or enclosed structures where a fire has gone beyond the incipient stage, and requires protective clothing and breathing apparatus.

Pre-fire Planning - The act of preparing to fight a fire in a particular building or group of buildings by advance planning of possible fire fighting operation. It is suggested that pre-fire planning be conducted by the local fire department considering the workplace and process hazards. Involvement with the local fire department or fire prevention bureau is encouraged to facilitate coordination and cooperation between members of the fire brigade and those who might be called upon for assistance during the fire emergency.

Fire Brigade Organizational Statement - A written statement that identifies the scope of the fire brigade, organizational structure, training requirements, brigade size, and functions of the brigade members.

Personal Protective Clothing - Clothing and equipment such as coat, boots, pants, helmet, gloves and breathing apparatus that shield the body from heat, smoke, fumes, and other harmful conditions.

GENERAL REQUIREMENTS

1910.156(a) This section contains requirements for the organization, training, and personal protective equipment of fire brigades. This section does not require an employer to organize a fire brigade. However, if an employer does decide to organize a fire brigade, the requirements of this section apply. The requirement of this section apply to fire brigades, industrial fire departments and private or contractual type fire departments.

NOTE: The requirements of this section do not apply to airport crash rescue, forest fire fighting operations and volunteer fire departments.

The organizational structure of a fire brigade must be designed to handle all plant emergencies. The number of members, scope of responsibility, plant physical characteristics, and specific hazards will determine how the fire brigade will be organized.

The way an employer will organize employees for fire fighting will depend on many variables such as the availability and skill of outside help (local fire

department), the proximity of the local fire department, the existing and potential dangers to personnel and property, the frequency of plant emergencies, the availability of qualified personnel to train and participate in the plant's emergency organization, as well as other factors that will be unique to each plant.

Organizational Statement

(1) The employer shall prepare and maintain a written policy which establishes the existence of a fire brigade.

(2) The basic organizational structure.

(3) The type, amount, and frequency of training to be provided to fire brigade members.

(4) The expected number of members in the fire brigade.

(5) The functions that the fire brigade is to perform at the workplace.

NOTE: The organizational statement shall be available for inspection by the Secretary of Labor and by employees or their designated representatives.

REQUIREMENTS FOR INCIPIENT STATE FIRE BRIGADE

(1) Provide a fire brigade organizational statement.

(2) Provide (organizational statement) duty training.

(3) Provide training and education in special hazards.

(4) Provide instructors with higher level training.

(5) Provide hands on training for Class II hose lines, portable fire extinguishers, and small hose lines **annually**.

REQUIREMENTS FOR INTERIOR STRUCTURAL FIRE BRIGADES

(1) Provide a fire brigade organizational statement.

(2) Assure member physical capability.

(3) Provide special hazard training.

(4) Provide instructors with higher level training.

(5) Provide personal protective equipment.

(6) Provide the training for duties in the fire brigade organizational statement.

(7) Provide education **at least annually**.

(8) Provide hands-on training **at least annually**.

1910.156(b)(2) The employer shall assure that employees who are expected to do interior structural fire fighting are physically capable of performing duties which may be assigned to them during emergencies. The employer shall not permit employees with known heart disease, epilepsy, or emphysema to participate in fire brigade emergency activities unless a physician certifies the employees' fitness to participate in such activities. For employees assigned to fire brigades on or after September 15, 1980, this paragraph is effective September 15, 1990. For employees assigned to fire brigades on or before September 15, 1980, this paragraph is effective December 15, 1980.

Advisory

All fire brigade members should be adequately trained to render first aid.

1910.156(c)(1) The employer shall provide training and education for all fire brigade members commensurate with those duties and functions that fire brigade members are expected to perform. Such training and education shall be provided to fire brigade members before they perform fire brigade emergency activities. Fire brigade leaders and training instructors shall be provided with training and education which is **more comprehensive** than that provided to the general membership of the fire brigade.

1910.156(c)(2) The employer shall assure that training and education is conducted frequently enough to assure that each member of the fire brigade is able to perform the member's assigned duties and functions satisfactorily and in a safe manner so as not to danger fire brigade members or other employees. All fire brigade members shall be provided with training **at least annually**. In addition, fire brigade members who are expected to perform interior structural fire fighting shall be provided with an education session or training **at least quarterly**.

1910.156(c)(4) The employer shall inform fire brigade members about special hazards

such as storage and use of flammable liquids and gases, toxic chemicals, radioactive sources, and water reactive substances, to which they may be exposed during fire and other emergencies. The fire brigade members shall also be advised of any changes that occur in relation to the special hazards. The employer shall develop and make available for inspection by fire brigade members, **written procedures** that describe the actions to be taken in situations involving the special hazards and shall include these in the training and education program.

1910.156(d) The employer shall maintain and inspect, **at least annually**, fire fighting equipment to assure the safe operational condition of the equipment. Portable fire extinguishers and respirators shall be inspected **at least monthly**. Fire fighting equipment that is in damaged or unserviceable condition shall be removed from service and replaced.

1910.156(e) The following requirements apply to those employees who perform interior structural fire fighting. The requirements do not apply to employees who use fire extinguishers or standpipe systems to control or extinguish fires only in the incipient stage.

1910.156(e)(1)(i) The employer shall provide at no cost to the employee and assure the use of protective clothing which complies with the requirements of this paragraph. The employer shall assure that protective clothing ordered or purchased after July 1, 1981, meets the requirements contained in this paragraph. As the new equipment is provided, the employer shall assure that all fire brigade members wear the equipment when performing interior structural fire fighting. After July 1, 1985, the employer shall assure that all fire brigade members wear protective clothing meeting the requirements of this paragraph when performing interior structural fire fighting.

1910.156(f)(1)(i) The employer shall provide at no cost to the employee and assure the use of respirators which comply with the requirements of this paragraph. The employer shall assure that respiratory protective devices worn by fire brigade members meet the requirements contained in 1910.134 and the requirements contained in this paragraph, and are certified under 30 CFR Part II.

1910.156(f)(1)(ii) Approved self-contained breathing apparatus with full facepiece, or with approved helmet or hood configuration, shall be provided to and worn by fire brigade members while working inside buildings or confined spaces where toxic products of combustion or an oxygen deficiency may be present. Such apparatus shall also be worn during emergency situations involving toxic substances.

1910.156(f)(1)(v) Self-contained breathing apparatus shall have a minimum service life rating of 30 minutes in accordance with the methods and requirements of the Mine Safety and Health Administration (MSHA) and NIOSH, except for escape self-contained breathing apparatus (ESCBA) used only for emergency escape purposes.

1910.156(f)(1)(vi) Self-contained breathing apparatus shall be provided with an indicator which automatically sounds an audible alarm when the remaining service life of the

apparatus is reduced to within a range of 20 to 25 percent of its rated service time.

1910.156(f)(2)(i) The employer shall assure that self-contained breathing apparatus ordered or purchased after July 1, 1981, for use by fire brigade members performing interior structural fire fighting operations, are of the pressure-demand or other positive-pressure type. Effective July 1, 1983, only pressure-demand or other positive-pressure self-contained breathing apparatus shall be worn by fire brigade members performing interior structural fire fighting.

1910.158 - STANDPIPE AND HOSE SYSTEMS

The purpose of standpipe systems is to provide hose connections inside a building. These connections may be in either a vertical or horizontal position and are usually located on each floor. They may also be located on roofs of buildings, in basements, or outside in open yard areas of large industrial plants. A standpipe system must be supplied with adequate water and pressure in order to be effective. Certain types of standpipes may be equipped with small fire hose and nozzles attached to the standpipe outlet for use by employees. Standpipe systems may be supplied by either a direct connection to the water supply, a fire department pumper, or both.

TYPES OF STANDPIPE SYSTEMS

Wet standpipe systems that have the water supply valve open and water in the system at all times.

Dry standpipe systems that admit water to the system through the operation of a manually activated control valve.

Dry standpipe systems that admit water to the system automatically through the use of approved devices such as dry-pipe valves.

Dry standpipe systems that have no permanent water supply and must be supplied with water by the fire department.

STANDPIPE SYSTEM CLASSIFICATION

Class I Standpipe System - A 2 1/2" (6.3 cm) hose connection for use by fire departments and those trained in handling heavy fire streams.

Class II Standpipe System - A 1 1/2" (3.8 cm) hose system which provides a means for the control of extinguisher of incipient stage fires.

Class III Standpipe System - A combined system of hose which is for the use of employees trained in the use of hose operation and which is capable of furnishing effective water discharge during the more advanced stages of fire (beyond the incipient stage) in the interior of workplaces. Hose outlets are available for both 1 1/2" (3.8 cm) and 2 1/2" (6.3 cm) hose.

Small Hose System - A system of hose ranging in diameter from 5/8" (1.6 cm) up to 1 1/2" (3.8 cm) which is for the use of employees and which provides a means for the control and extinguishment of incipient stage fires.

NOTE: Hose stations may also be attached to sprinkler systems. Refer to 1910.159(c)(5).

REQUIREMENTS

This section has been written to provide adequate coverage of those standpipe and hose systems that an employer may install in the workplace to meet the requirements of a particular OSH standard. For example, OSH permits the substitution of hose systems for portable fire extinguishers in 1910.157. If an employer chooses to provide hose systems instead of portable Class A fire extinguishers, then those hose systems used for substitution would have to meet the applicable requirements of 1910.158. All other standpipe and hose systems not used as a substitute would be exempt from these requirements.

The section specifically exempts Class I large hose systems. By large hose systems, OSH means those 2 1/2" hose lines that are usually associated with fire departments of that size that would provide their own water supply through fire apparatus. When the fire gets to the size that outside protection of that degree is necessary, OSH believes that in most industries employees will have been evacuated from the fire area and the "professional" fire fighters will have control.

Protection of Standpipes

1910.158(b) The employer shall assure that standpipes are located or otherwise protected against mechanical damage. Damaged standpipes shall be repaired promptly.

Equipment

1910.158(c)(1) Where reels or cabinets are provided to contain fire hose, the employer shall assure that they are designed to facilitate prompt use of the hose valves, the hose, and other equipment at the time of a fire or other emergency. The employer shall assure that the reels and cabinets are conspicuously identified and used only for fire protection.

1910.158(c)(2)(i) The employer shall assure that hose outlets and connections are located high enough above the floor to avoid being obstructed and to be accessible to employees.

1910.158(c)(2)(ii) The employer shall standardize screw threads or provide appropriate adapters throughout the system and assure that the hose connections are compatible with those used on the supporting fire equipment.

1910.158(c)(3)(i) The employer shall assure that every 1 1/2" (3.8 cm) or smaller hose outlet used to meet this standard is equipped with hose connected and ready for use. In extremely cold climates where such installations may result in damaged equipment, the hose may be stored in another location provided it is readily available and can be connected when needed.

Advisory Note:

Hose length should be long enough to reach the hazard(s) protected. NFPA Standard 14 indicates that hose should reach within 30 feet of the protected hazard. This is not an OSH standard, but may be used as a guide.

1910.158(c)(3)(ii) Standpipe systems installed after January 1, 1981, for use by employees, shall be equipped with **lined hose**. Unlined hose may remain in use on existing systems. However, after the effective date of this standard, unlined hose which becomes unserviceable shall be replaced with lined hose.

1910.158(c)(3)(iii) Beginning January 1, 1981, the employer shall provide hose of such length that friction loss resulting from water flow through the hose will not decrease the pressure at the nozzle below **30 psi (210 kPa)**. The dynamic pressure at the nozzle shall be within the **range of 30 psi (210 kPa) to 125 psi (860 kPa)**.

1910.158(c)(4) Beginning July 1, 1981, the employer shall assure that standpipe hose is equipped with shut-off type nozzles.

NOTE: Variable stream nozzles can provide useful variations in water flow and spray patterns during fire fighting operations and they are recommended for employee use. It is recommended that 100 psi nozzle pressure be used to provide good flow patterns for variable stream nozzles. The most desirable attribute for nozzles is the ability of the nozzle person to shut off the water flow at the nozzle when it is necessary. This can be accomplished in many ways. For example, a shut-off nozzle with a lever or rotation of the nozzle to stop flow would be effective, but in other cases a simple globe valve placed between a straight stream nozzle and the hose could serve the same purpose. For straight stream nozzles 50 psi nozzle pressure is recommended. The intent of this standard is to protect the employee from "run-away"

hoses if it becomes necessary to drop a pressurized hose line and retreat from the fire front and other related hazards.

1910.158(d) The minimum water supply for standpipe and hose systems, which are provided for the use of employees, shall be sufficient to provide **100 gallons per minute** (6.3 l/s) for a period of **at least 30 minutes**.

NOTE: The amount of water required for standpipe systems depends upon the size and number of fire streams that will be needed and probable length of time they will be used. Both of these factors are largely influenced by the construction and occupancy of the building or plant. When the character of the water supply must be studied and specific conditions such as acceptability, pumps, tanks, and sprinkler systems must be considered, NFPA 14, Standard for the Installation of Standpipe and Hose Systems, should be consulted.

To determine nozzle pressure, you must know the standpipe pressure. The pressure must be modified by (3) factors:

- Friction loss in hose.
- Friction loss in standpipe.
- Elevation loss or gain.

To insure adequate water supply and nozzle pressure, requires some basic knowledge of fire service hydraulics, and use of devices for measuring water pressure.

An engineer having obtained information from a flow test, and having at hand other necessary data with reference to elevations, length, and diameter of pipes (and, on occasion, information as to peculiarities of a given water supply system) may, by a few simple calculations, predict the amount of water that might be obtained at certain residual pressures at other locations, in a simple underground piping system.

Additional information and assistance on the subject can be obtained from various sources or by contacting the "Division of Education and Training" listed on the back cover of this booklet.

Tests

1910.158(e)(1)(i) The employer shall assure that the piping of Class II and III systems installed after January 1, 1981, including yard piping, is hydrostatically tested for a period of **at least 2 hours at not less than 200 psi** (1380 kPA), or **at least 50 psi** (340 kPa) **in excess of normal pressure** when such pressure is greater than 150 psi (1030 kPa).

1910.158(e)(1)(ii) The employer shall assure that hose on all standpipe systems installed after January 1, 1981, is hydrostatically tested with couplings in place, at pressure of not less than 200 psi (1380 kPa), before it is placed in service.

This pressure shall be maintained for at least 15 seconds and not more than one minute during which time the hose shall not leak nor shall any jacket thread break during the test.

Maintenance

1910.158(e)(2)(i) The employer shall assure that water supply tanks are kept filled to the proper level except during repairs. When pressure tanks are used, the employer shall assure that proper pressure is maintained at all times except during repairs.

1910.158(e)(2)(ii) The employer shall assure the valves in the main piping connections to the automatic sources of water supply are kept fully open at all times except during repair.

1910.158(e)(2)(iii) The employer shall assure that hose systems are inspected **at least annually and after each use** to assure that all of the equipment and hose are in place, available for use, and in serviceable condition.

1910.158(e)(2)(iv) When the system or any portion thereof is found not to be serviceable, the employer shall remove it from service immediately and replace it with equivalent protection such as extinguishers and fire watches.

1910.158(e)(2)(v) The employer shall assure that hemp or lined hose on existing systems is unracked, physically inspected for deterioration, and reracked using a different fold pattern **at least annually**. The employer shall assure that defective hose is replaced in accordance with paragraph (c)(3)(ii).

1910.158(e)(2)(vi) The employer shall designate trained persons to conduct all inspections required under this section.

1910.159 - AUTOMATIC SPRINKLER SYSTEMS

DEFINITIONS

Sprinkler System - A system of piping designed in accordance with fire protection engineering standards and installed to control or extinguish fires. The system includes an adequate and reliable water supply, and a network of specially sized piping and sprinklers which are interconnected. The system also includes a control valve and a device for actuating an alarm when the system is in operation.

Sprinkler Connection - A siamese connection used by the fire department for increasing the water supply and pressure to a sprinkler system.

Wet-Pipe Sprinkler System - An automatic sprinkler system in which the pipes are constantly filled with water under pressure.

Dry-Pipe Sprinkler System - A fire protection sprinkler system that has air instead of water under pressure in its piping; dry systems are often installed in areas subject to freezing.

Dry-Pipe Valve - A valve in a dry-pipe sprinkler system designed so that moderate air pressure will hold back a much greater water pressure.

Deluge Sprinkler System - A fire protection sprinkler system in which the sprinkler heads are always open. The system is controlled by a valve that is operated automatically or by a thermostatically-actuated device.

Pre-Action System - A type of automatic sprinkler system in which thermostatic devices are employed to charge the system with water before individual sprinkler heads are fused.

Fire Department Connection - Connections provided at ground level through which the fire department supplies sprinkler systems or standpipe systems.

Post Indicator Valve (PIV) - A post-type valve that provides a visual means of indicating "open" or "shut" position. It is found on the supply main of installed fire protection systems.

OS & Y Valve - A type of outside screw and yoke valve used on piping or in pits connected to sprinkler systems. The position of the stem shows the valve to be either open or closed.

Sprinkler Alarm - An approved device installed so that any waterflow from a sprinkler system equal to or greater than that from single automatic sprinkler will result in an audible alarm signal on the premises.

REQUIREMENTS

The requirements of this section apply to all automatic sprinkler systems installed to meet a particular OSH standard. For automatic sprinkler systems used to meet OSH requirements and installed prior to the effective date of this standard, compliance with the National Fire Protection Association (NFPA) or the National Board of Fire Underwriters (NBFU) standard in effect at the time of the system's installation will be acceptable as compliance with this section. Automatic sprinkler systems installed in workplaces, but not required by OSH, are exempt from the requirements of this section.

NOTE: Systems installed *solely* for property protection are not covered.

Design

There are two basic types of sprinkler system designs. Pipe schedule designed systems are based on pipe schedule tables developed to control hazards with standard size pipe, number of sprinklers, and pipe lengths. Hydraulic designed systems are based on an engineered design of pipe size which will produce a given water density or flow rate at any particular point in the system. Either design can be used to comply with this standard.

The National Fire Protection Association's Standard No. 13, "Automatic Sprinkler Systems," contains the tables needed to design and install either type of system. Minimum water supplies, densities, and pipe sizes are given for all types of occupancies.

The employer may check with a reputable fire protection engineering consultant or sprinkler design company when evaluating existing systems or designing new installations.

With the advent of new construction materials for the manufacture of sprinkler pipe, materials, other than steel have been approved for use as sprinkler pipe. Selection of pipe material should be made on the basis of the type of installation and the acceptability of the material to local fire and building officials where such systems may serve more than one purpose.

Before new sprinkler systems are placed into service, an acceptance test is to be conducted. The employer should invite the installer, designer, insurance representative, and a local fire official to witness the test. Problems found during the test are to be corrected before the system is placed into service.

1910.159(c)(1)(i) All automatic sprinkler designs used to comply with this standard shall provide the necessary discharge patterns, densities, and water flow characteristics for complete coverage in a particular workplace or zoned subdivision of the workplace.

1910.159(c)(1)(ii) The employer shall assure that only approved equipment and devices are used in the design and installation of automatic sprinkler systems used to comply with this standard.

NOTE: Systems must be properly maintained, for example:

- **Water supply valves open and checked regularly.**
- **Dry pipe valves cleaned and reset annually (maintain air pressure in the system).**

Maintenance

It is important that any sprinkler system maintenance be done only when there is minimal employee exposure to the fire hazard. For example, if repairs or changes to the system are to be made, they should be made during those hours when employees are not working or are not occupying that portion of the workplace protected by the portion of the system which has been shut down.

The procedures for performing a flow test via a main drain test or by the use of an inspector's test valve can be obtained from the employer's fire insurance company or from the National Fire Protection Association's Standard No. 13A, "Sprinkler System, Maintenance."

1910.159(c)(2) The employer shall properly maintain an automatic sprinkler system installed to comply with this section. The employer shall assure that a main drain flow test is performed on each system **annually**. The inspector's test valve shall be opened **at least every two years** to assure that the sprinkler system operates properly.

Acceptance Tests

1910.159(c)(3) The employer shall conduct proper acceptance tests on sprinkler systems installed for employee protection after January 1, 1981, and record the dates of such tests. Proper acceptance tests include the following:

- Flushing of underground connections.
- Hydrostatic tests of piping in system.
- Air tests in dry-pipe systems.
- Dry-pipe valve operations; and
- Test of drainage facilities.

Water Supplies

The water supply to a sprinkler system is one of the most important factors an employer should consider when evaluating a system. Obviously, if there is no water supply, the system is useless. Water supplies can be lost for various reasons such as improperly closed valves, excessive demand, broken water mains, and broken fire pumps. The employer must be able to determine if or when this type of condition exists either by performing a main drain test or visual inspection. Another problem may be an inadequate water supply. For example, a light hazard occupancy may, through rehabilitation or change in tenants, become an ordinary or high hazard occupancy. In such cases, the existing water supply may not be able to provide the pressure or duration necessary for proper protection. Employers must assure that proper design and tests have been made to assure an adequate water supply. These tests can be arranged through the employer's fire insurance carrier or through a local sprinkler maintenance company or through the local fire prevention organization.

Anytime the employer must shut down the primary water supply for a sprinkler system, the standard requires that equivalent protection be provided. Equivalent protection may include a

fire watch with extinguishers or hose lines in place and manned, or a secondary water supply such as a tank truck and pump, or a tank or fire pond with fire pumps, to protect the areas where the primary water supply is limited or shut down. The employer may also require evacuation of the workplace and have an emergency action plan which specifies such actions.

1910.159(c)(4) The employers shall assure that every automatic sprinkler system is provided with at least one automatic water supply capable of providing design water flow for at least 30 minutes. An auxiliary water supply or equivalent protection shall be provided when the automatic water supply is out of service, except for systems of 20 or fewer sprinklers.

Hose Connections for Fire Fighting Use

1910.159(c)(5) The employer may attach hose connections for fire fighting use to wet pipe sprinkler systems provided that the water supply satisfies the combined design demand for sprinklers and standpipes.

Protection of Piping

Piping which is exposed to corrosive atmospheres, either chemical or natural, can become defective to the extent that it is useless. Employers must assure that piping is protected from corrosion by its material of construction, e.g., stainless steel, or by a protective coating, e.g., paint.

1910.159(c)(6) The employer shall assure that automatic sprinkler system piping is provided against freezing and exterior surface corrosion.

Drainage

1910.159(c)(7) The employer shall assure that all dry sprinkler pipes and fittings are installed so that the systems may be totally drained.

Sprinklers

1910.159(c)(8)(i) The employer shall assure that only approved sprinklers are used on systems.

1910.159(c)(8)(ii) The employer may not use older style sprinklers to replace standard sprinklers without a complete engineering review of the altered part of the system.

1910.159(c)(8)(iii) The employer shall assure that sprinklers are protected from mechanical damage.

1910.159(c)(9) On all sprinkler systems having more than 20 sprinklers, the employer

shall assure that a local waterflow alarm is provided which sounds an audible signal on the premises upon waterflow through the system equal to the flow from a single sprinkler.

1910.159(c)(10) The employer shall assure that sprinklers are spaced to provide a maximum protection area per sprinkler, a minimum of interference to the discharge pattern by building or structural members or building contents and suitable sensitivity to possible fire hazards. The **minimum vertical clearance between sprinklers and material below shall be 18 inches**.

1910.159(c)(11) The employer shall assure that hydraulically designed automatic sprinkler systems or portions thereof are identified and that the location, number of sprinklers in the hydraulically designed section, and the basis of the design is indicated. Central records may be used in lieu of signs at sprinkler valves provided the records are available for inspection and copying by the Secretary of Labor.

NOTE: Automatic sprinkler systems are considered to be the most reliable of all fire protection devices, and an understanding of the system of pipes and valves and their operation is essential to the fire brigade members. ***If more than one sprinkler head is operating, the fire may be beyond the incipient stage.*** **Additional information and assistance on the subject can be obtained from various sources or by contacting the "Division of Education and Training."**

1910.160 - 1910.165
FIXED EXTINGUISHING SYSTEMS, FIRE DETECTION SYSTEMS AND EMPLOYEE ALARM SYSTEMS

DEFINITIONS

Automatic Fire Detection Devices - A device designed to automatically detect the presence of fire by heat, flame, light, smoke or other products of combination.

Carbon Dioxide - A colorless, odorless, electrically nonconductive inert gas (chemical formula CO^2) that is a medium for extinguishing fires by reducing the concentration of oxygen or fuel vapor in the air to the point where combustion is impossible.

Dry Chemical - An extinguishing agent composed of very small particles of chemicals such as, but not limited to, sodium bicarbonate, potassium chloride or monoammonium phosphate supplemented by special treatment to provide resistance to packing and moisture absorption (caking) as well as to provide proper flow capabilities. Dry chemical does not include dry powders.

Fixed Extinguishing System - A permanently installed system that either extinguishes or controls a fire at the location of the system.

Foam - A stable aggregation of small bubbles which flow freely over a burning liquid surface and form a coherent blanket which seals combustible vapors and thereby extinguishes the fire.

Gaseous Agent - A fire extinguishing agent which is in the gaseous state at normal room temperature and pressure. It has low viscosity, can expand or contract with changes in pressure and temperature, and has the ability to diffuse readily and to distribute itself uniformly throughout an enclosure.

Halon 1211 - A colorless, faintly sweet smelling, electrically nonconductive liquefied gas (chemical formula $CBrCIF_2$) which is a medium for extinguishing fires by inhibiting the chemical chain reaction of fuel and oxygen. It is also known as bromochlorodi-fluoromethane.

Halon 1301 - A colorless, odorless, electrically nonconductive gas (chemical formula $CBrF_3$) which is a medium for extinguishing fires by inhibiting the chemical chain reaction of fuel and oxygen. It is also known as bromotrifluoromethane.

Inspection - A visual check of fire protection systems and equipment to ensure that they are in place, charged, and ready for use in the event of a fire.

Local Application System - A fixed fire suppression system which has a supply of extinguishing agent, with nozzles arranged to automatically discharge extinguishing agent directly on the burning material to extinguish or control a fire.

Maintenance - The performance of services on fire protection equipment and systems to assure that they will perform as expected in the event of a fire. Maintenance differs from

inspection in that the maintenance requires the checking of internal fitting, devices and agent supplies.

Pre-Discharge Employee Alarm - An alarm which will sound at a set time prior to actual discharge of an extinguishing system so that employees may evacuate the discharge area prior to system discharge.

Total Flooding System - A fixed suppression system which is arranged to auto-matically discharge a predetermined concentration of agent into an enclosed space for the purpose of fire extinguishment or control.

NOTE: Due to the phasing out of Halon production, the NFPA standard lists several non-conductive fire extinguishing agents that do not leave a residue that could be considered for replacement of the Halon in systems.

1910.160 - FIXED EXTINGUISHER SYSTEMS

Fixed extinguishing systems are designed and installed for fire suppression with minimal loss of property, equipment, processes and goods. They are used to protect dip tanks, spray painting booths and flammable liquid hazards. They are also recommended to protect areas where the contents are susceptible to water damage, such as fur and record vaults and computer rooms and equipment.

1910.160 through 1910.163 applies to all fixed extinguishing systems installed to meet a particular OSH standard except for automatic sprinkler systems which are covered by 1910.159.

NOTE: The standards which require fixed extinguisher systems include but are not necessarily limited to the following:

Dip tanks, 1910.108(c)(5)
Spray painting booths, 1910.107(b)(5)(iv) and 1910.107(h)(12)
Flammable liquid storage, 1910.106, Table H-13

1910.160(a)(2)

Applies to those fixed extinguishing systems, generally total flooding, which are **not** required by OSH, but which, because of the agent's discharge, may expose employees to hazardous concentrations of extinguishing agents or combustion by-products. Employees who work around fixed extinguishing systems must be warned of the possible hazards associated with the system and its agent. For example, fixed dry chemical extinguishing systems may generate a large enough cloud of dry chemical particles that employees may become visually disoriented. Certain gaseous agents can expose employees to hazardous by-products of combustion when the agent comes into contact with hot metal or other hot surfaces. Some gaseous agents may be present in hazardous concentrations when the system has totally discharged because an extra rich concentration is necessary to extinguish deep-seated fires. Certain local application systems may be designed to discharge onto the flaming surface of a liquid, and it is possible that the liquid can splatter when hit with the discharging agent. All of these hazards must be determined before the system is placed into operation, and must be discussed with employees.

Such systems are only subject to the requirements of 1910.160(b)(4) through (b)(7) and 1910.160(c).

Systems otherwise covered in 1910.160(a)(2), which are installed in areas with no employee exposure are exempt from the requirements of 1910.160.

1910.160(b)(1)

System components and application of agents must be approved and designed for the specific fire hazard they are installed to control or extinguish.

NOTE: The following elements should be considered in the design of the system:

- **agent concentration**
- **total agent quantity**
- **application rate**
- **pressure of the cylinder**
- **nozzle quantity and arrangement for coverage**

1910.160(b)(2) If for any reason a fixed extinguishing system becomes inoperable, the employer shall notify employees and take the necessary temporary precautions to assure their safety until the system is restored to operating order. Any defect or impairments shall be properly corrected by trained personnel.

NOTE: Some possibilities are:

- **fire watch in area**
- **hazardous operations discontinued**
- **restriction of employee access to area**

1910.160(b)(3) A distinctive alarm or signaling system which complied with 1910.165 is required to indicate that a fixed system is discharging. Such a signal is necessary on those systems where it is not immediately apparent that the system is discharging. For example, certain gaseous agents make a loud noise when they discharge. In this case no alarm signal is necessary. However, where systems are located in remote locations or away from the general work area and where it is possible that a system could discharge without anyone knowing that it is doing so, then a distinctive alarm is necessary to warn employees of the hazards that may exist. The alarm can be a bell, gong, whistle, horn, flashing light, or any combination of signals as long as it is identifiable as a discharge alarm.

1910.160(b)(4) The employer shall provide effective safeguards to warn employees against entry into discharge areas where the atmosphere remains hazardous to employee safety or health.

NOTE: There should also be a method to warn employees against reentry into a space flooded with extinguishing agent. This could be:

- **a continuation of the discharge alarm**
- **separate warning light**
- **physical barrier**
- **employee guard**

1910.160(b)(5) The employer shall post hazard warning or caution signs at the entrance

to, and inside of, areas protected by fixed extinguishing systems which use agents in concentrations known to be hazardous to employee safety and health.

1910.160(b)(6) The employer shall assure that fixed systems are inspected annually by a person knowledgeable in the design and function of the system to assure that the system is maintained in good operating condition.

NOTE: The employer is responsible for the maintenance of all fixed systems; but this responsibility does not preclude the use of outside contractors to do such work. New systems should be subjected to an acceptance test before placed in service. The employer should invite the installer, designer, insurance representatives and others to witness the test. Problems found during the test need to be corrected before the system is considered operational.

1910.160(b)(9) The employer shall assure that inspection and maintenance dates are recorded on the container, on a tag attached to the container, or in a central location. A record of the last **semi-annual check** shall be maintained until the container is checked again or for the life of the container, whichever is less.

1910.160(b)(11) The employer shall not use chlorobromomethane or carbon tetrachloride as an extinguishing agent where employees may be exposed.

NOTE: Based on the known toxicological effects of agents such as carbon tetrachloride and chlorobromomethane, OSH is not permit-ting the use of these agents in areas where employees can be exposed to the agent or its side effects. However, chlorobromo-methane has been accepted and may be used as an explosion suppression agent in unoccupied spaces. OSH is permitting the use of this agent only in areas where employees will not be exposed.

1910.160(b)(12) The employer shall assure that systems installed in the presence of corrosive atmospheres are constructed of non-corrosive material or otherwise protected against corrosion.

NOTE: Where components are subject to corrosion, corrosion protection must be provided by:

- **non-corrosive materials (i.e., stainless steel)**
- **wax coatings**

- **paint protection**

Paint on operating components should be factory applied. Field applied paint can cause malfunction of sensitive parts.

1910.160(b)(15) The employer shall assure that at least one manual station is provided for discharge activation of each fixed extinguishing system.

NOTE: There are instances, such as for mechanical reasons and

others, where the standards call for a manual back-up activation device. While the location of this device is not specified in the standard, the employer should assume that the device should be located where employees can easily reach it. It could, for example, be located along the main means of egress from the protected area so that employees could activate the system as they evacuate the work area.

1910.160(b)(16) The employer shall assure that manual operating devices are identified as to the hazard against which they will provide protection.

1910.160(b)(17) The employer is required to provide the necessary personal protective equipment to rescue employees who may be trapped in a totally flooded environment which may be hazardous to their health. The equipment would normally include a positive-pressure self-contained breathing apparatus and any necessary first aid equipment. In cases where the employer can assure the prompt arrival of the local fire department or plant emergency personnel which can provide the equipment, this can be considered as complying with the standards.

Total flooding systems with potential health and safety hazards to employees.

1910.160(c)(1) The employer shall provide an emergency action plan in accordance with 1910.38 for each area within a workplace that is protected by a total flooding system which provides agent concentrations exceeding the maximum safe levels set forth in paragraphs (b)(5) and (b)(6) of 1910.162.

NOTE: Requirements of this paragraph apply to systems in areas that employees could possibly enter either during or after system operation.

There must be an emergency action plan (see 1910.38) for each area where agent concentration could exceed the maximum safe level. This includes:

- any CO^2 system of 4% or more
- any Halon 1211 system of 4% or more
- Halon 1301 systems with a designed concentration of 10% or more

These systems must be automatically actuated, with fire detectors interconnected to pre-discharge alarms. The alarm must provide sufficient time for employee escape before the system discharges.

1910.160(c)(2) Systems installed in areas where employees cannot enter during or after the system's operation are exempt from the requirement of paragraph (c) of this section.

1910.160(c)(3) On all total flooding systems the employer shall provide a **pre-discharge employee alarm** which complies with 1910.165, and is capable of being

perceived above ambient light or noise levels before the system discharges, which will give employees time to safely exit from the discharge area prior to system discharge.

1910.160(c)(4) The employer shall provide automatic actuation of total flooding systems by means of an approved fire detection device installed and interconnected with a **pre-discharge employee alarm system** to give employees time to safely exit from the discharge area prior to system discharge.

1910.161 - FIXED EXTINGUISHER SYSTEMS, DRY CHEMICAL

The requirements of this section apply only to dry chemical systems. These requirements are **to be used in conjunction with** the requirements of 1910.160.

1910.161(b)(1) The employer shall assure that dry chemical agents are compatible with any foams or wetting agents with which they are used.

1910.161(b)(2) The employer may not mix together dry chemical extinguishing agents of different compositions. The employer shall assure that dry chemical systems are refilled with the chemical stated on the approved name plate or any equivalent compatible material.

1910.161(b)(3) When dry chemical discharge may obscure vision, the employer shall provide a pre-discharge employee alarm which complies with 1910.165 and which will give employees time to safely exit from the discharge area prior to system discharge.

NOTE: Pre-discharge alarms are needed on dry chemical systems only when the dry chemical discharge could obstruct vision, such as:

- **equipment located along a main egress route**

- **equipment in a confined space where employees in the immediate area could have difficulty seeing their way out**

1910.161(b)(4) The employer shall sample the dry chemical supply of all but stored pressure systems at least annually to assure that the dry chemical supply is free of moisture which may cause the supply to cake or form lumps.

NOTE: The employer is responsible for assuring that dry chemical systems will operate effectively. To do this, periodic maintenance is necessary. One test that must be conducted during the maintenance check is one which will determine if the agent has remained free of moisture. If an agent absorbs any moisture, it may tend to cake and thereby clog the system. An easy test for acceptable moisture content is to take a lump of dry chemical from the container and drop it from a height of four inches. If the lump crumbles into fine particles, the agent is acceptable.

1910.161(b)(5) The employer shall assure that the rate of application of dry chemicals is such that the designed concentration of the system will be reached within 30 seconds of initial discharge.

1910.162 - FIXED EXTINGUISHING SYSTEMS, GASEOUS AGENTS

This section applies only to those systems which use gaseous agents. The requirements of 1910.160 also apply to the gaseous agent systems covered in this section.

1910.162(b)(2) and (b)(4) through (b)(7) shall apply only to total flooding systems.

1910.162(b)(1) applies to local application systems.

SPECIFIC REQUIREMENTS

Agents must be approved for the system application. A system designed for one agent cannot use another agent without significant redesign. (Halon 1301 and Halon 1211 are not interchangeable.)

1910.162(b)(2) Except during overhaul, the employer shall assure that the designed concentration of gaseous agents is maintained until the fire has been extinguished or is under control.

NOTE: A critical factor in total flooding systems is the ability to maintain the concentration of agent in the room or space until the fire goes out. The following are common sources of leakage:

- **ventilation fans and ducts**
- **door, window, and conveyor openings**
- **floor drains, etc.**

These openings must be:

- **closed to minimize leakage, or**
- **additional agent must be provided to allow for the agent loss**

1910.162(b)(3) The employer shall assure that employees are not exposed to toxic levels of gaseous agent or its decomposition products.

NOTE: Total flooding gaseous systems are based on the volume of gas which must be discharged in order to produce a certain designed concentration of gas in an enclosed area. The concentration needed to extinguish a fire depends on several factors including the type of fire hazard and the amount of gas expected to leak away from the area during discharge. At times it is necessary to "super-saturate" a work area to provide for expected leakage from the enclosed area. In such cases,

employers must assure that the flooded area has been ventilated

before employees are permitted to reenter the work area without protective clothing and respirators.

Toxic decomposition. Certain halogenated hydrocarbons will break down or decompose when they are combined with high temperatures found in the fire environment. The products of the decomposition can include toxic elements or compounds. For example, when Halon 1211 is placed into contact with hot metal it will break down and form bromide or fluoride fumes. The employer must find out which toxic products may result from decomposition of a particular agent from the manufacturer, and take the necessary precautions to prevent employee exposure to the hazard.

One problem encountered with Halon extinguishing systems is the toxic decomposition products when Halon is exposed to temperatures over 950^{o}F.

Products include inorganic acids and carbonyl halides, including:

- hydrogen fluoride (HF)
- hydrogen bromide (HBr)
- carbonyl bromide ($COBr_2$)

The best controls to minimize toxicity problems are:

- adequate design concentration
- automatic operation
- rapid application
- employee evacuation of discharge area

1910.162(b)(4) The employer shall assure that the design extinguishing concentration is reached **within 30 seconds** of initial discharge except for Halon systems which must achieve design concentration **within 10 seconds**.

NOTE: This allows the fire to be extinguished before surfaces are heated, and minimizes the decomposition products.

1910.162(b)(5) The employer shall provide a distinctive pre-discharge employee alarm capable of being perceived above ambient light or noise levels when agent design concentrations exceed the maximum safe level for employee exposure. A pre-discharge employee alarm for alerting employees before system discharge shall be provided on Halon 1211 and carbon dioxide systems with a design concentration of **4 percent or greater** and for Halon 1301 system with a design concentration of **10 percent or greater**. The pre-discharge employee alarm shall provide employees time to safely exit the discharge area prior to system discharge.

1910.162(b)(6) (i) Where egress from an area cannot be accomplished within one minute, the employer **shall not use** Halon 1301 in concentrations greater than 7

percent.

(ii) Where egress takes greater than 30 seconds but less than one minute, the employer **shall not use** Halon 1301 in a concentration greater than 10 percent.

(iii) Halon 1301 **concentrations greater than 10 percent** are only permitted in areas not normally occupied by employees provided that any employee in the area can escape within 30 seconds. The employer shall assure that no unprotected employees enter the area during agent discharge.

1910.163 - FIXED EXTINGUISHING SYSTEMS, WATER SPRAY AND FOAM

This section applies to those systems to use water spray or foam. **The requirements of 1910.160 also apply** to this type of system.

1910.163(b)(1) The employer shall assure that foam and water spray systems are designed to be effective in at least controlling fire in the protected area or on protected equipment.

NOTE: System selection and design has to be effective for the protected hazard. Selection of foam is a critical factor. Two general categories of foam are:

- **high expansion**
- **low expansion**

High expansion foam produces 100 to 1,000 gallons of foam per gallon of water and foam solution-light stiff foam with little water content. Because of the high volume output, it fills protected volumes very quickly.

Because of its light weight, it tends to blow away if used outdoors.

Common uses:

- aircraft hangars
- basements
- warehouses
- other large confined spaces
- flammable liquid hazards

Not suitable for:

- any outdoor application
- combustible metal fires

Low expansion foams with expansion ratios of 6-10:1 produce a wet, sloppy foam with a higher water content. They extinguish fires by forming a blanket over the burning material, and by a cooling effect.

They are commonly used for flammable liquid hazards, such as:

- tank farms
- dip tanks

- piped lube oil systems, etc.

They are not good for combustible metal fires.

Common flammable liquids are also divided into two categories – polar and non-polar. Common polar solvents are:

- alcohol
- acetone
- other ketones

Common non-polar flammable liquids are:

- hexane
- toluene
- gasoline
- paint thinners
- lube oils

Common foams are suitable only for non-polar solvents. Special foams are required for polar flammable liquids. These are known as alcohol type foams or polar solvent foams.

NOTE: When selecting the type of foam for a specific hazard, the employer should consider the following limitations of some foams.

a. Some foams are not acceptable for use on fires involving flammable gases and liquefied gases with boiling points below ambient workplace temperatures. Other foams are not effective when used on fires involving polar solvent liquids.

b. Any agent using water as part of the mixture should not be used on fire involving combustible metals unless it is applied under proper conditions to reduce the temperature of burning metal below the ignition temperatures. The employer should use only those foams that have been tested and accepted for this application by a recognized independent testing laboratory.

c. Certain types of foams may be incompatible and break down when they are mixed together.

d. For fires involving water miscible solvents, employers should use only those foams tested and approved for such use. Regular protein foams may not be effective on such solvents.

1910.163(b)(2) The employer shall assure that drainage of water spray systems is directed away from areas where employees are working and that no emergency egress is permitted through the drainage path.

NOTE: Whenever employers provide a foam or water spray system, *drainage facilities must be provided* to carry contaminated water or foam overflow away from the employee work areas and egress routes. This drainage system should drain to a central impounding area where it can be collected and disposed of properly. Other government agencies may have regulations concerning environmental considerations.

Both foam and water spray systems can present a hazard to employees in the discharge area. Extinguishing agents in these systems can wash burning liquid away from the fire into surrounding areas. A dike keeps liquid away from work areas and egress paths where employees could be exposed.

This may require a combination of:

- dikes
- curbs
- floor slopes
- drains

to channel the flow through safe areas.

1910.164 - FIRE DETECTION SYSTEMS

This section applies to all automatic fire detection systems installed to meet the requirements of a particular OSH standard such as 1910.160(b)(13).

1910.164(b)(1) The employer shall assure that all devices and equipment constructed and installed to comply with this standard are approved for the purpose for which they are intended.

NOTE: Four general types of heat detectors:

- **fixed temperature**
- **rate-of-rise**
- **rate compensation (anticipation)**
- **combination rate-of-rise and fixed temperature**

Uses of Smoke Detectors

Smoke detectors are particularly useful when anticipated fire would produce smoke and combustion products before heat. Principle applications:

- areas of human occupancy
- high value or critical areas
- computer rooms
- control rooms

NOTE: Fire detection system must be designed by knowledgeable engineers or other professionals with expertise in fire detection systems; and when the systems are installed, there should be an acceptance test performed on the system to insure it operates properly. The manufacturer's recommendations for system design should be consulted. While entire systems may not be approved, each component used in the system is required to be approved. Custom fire detection systems should be designed by knowledge-able fire protection or electrical engineers who are familiar with the workplace hazards and conditions. Some systems may only have one or two individual detectors for a small workplace, but good design and installation is still important. An acceptance test should be performed on all systems, including these smaller systems.

1910.164(b)(2) The employer shall restore all fire detection systems and components to normal operating conditions as promptly as possible after each test or

alarm. Spare detection devices and components which are normally destroyed in the process of detecting fires shall be available on the premises or from a local supplier in sufficient quantities and locations for prompt restoration of the system.

NOTE: This does not mean that the parts or components have to be stored at the workplace. If the employer can assure that the supply of parts is available in the local community or the general metropolitan area of the workplace, then the requirements for storage and availability have been met. The intent is to make sure that the alarm system is fully operational when employees are occupying the workplace, and that when the system becomes inoperable it can be returned to full service the next day or sooner.

1910.164(c)(1) The employer shall maintain all systems in a operable condition except during repairs or maintenance.

NOTE: No specific method or interval is established for maintenance. Refer to the manufacturer's instructions for each specific system.

1910.164(c)(2) The employer shall assure that fire detectors and fire detection systems are tested and adjusted as often as needed to maintain proper reliability and operating condition except that factory calibrated detectors need not be adjusted after installation.

1910.164(c)(3) The employer shall assure that pneumatic and hydraulic operated detection systems installed after January 1, 1981, is equipped with supervised systems.

NOTE: Fire detection system should be supervised. The object of supervision is detection of any failure of the circuitry, and the employer should use any method that will assure that the system's circuits are operational. Electrically operated sensors for air pressure, fluid pressure, or electrical circuits, can provide effective monitoring and are the typical types of supervision.

Supervision is a specific term related to electrical circuitry. Monitoring is a more general term, which could include use of pressure switches to detect air leaks in pneumatic systems or similar approaches.

For some types of systems, there is no mechanical or electrical device which can monitor system performance. In this case, monitoring might only be a frequent testing program.

1910.164(c)(4) The employer shall assure that the servicing, maintenance and testing of fire detection systems, including cleaning and necessary sensitivity

adjustments are performed by a trained person knowledgeable in the operations and functions of the system.

1910.164(c)(5) The employer shall also assure that fire detectors that need to be cleaned of dirt, dust, or other particulates in order to be fully operational are

cleaned at regular periodic intervals.

1910.164(d)(1) The employer shall assure that fire detection equipment installed outdoors or in the presence of corrosive atmospheres to be protected from corrosion. The employer shall provide a canopy, hood, or other suitable protection for detection equipment requiring protection from the weather.

NOTE: Fire detectors must be protected from corrosion either by protective coatings, by being manufactured from non-corrosive materials or by location. Detectors must also be protected from mechanical impact damage, either by suitable cages or metal guards where such hazards are present, or by locating them above or out of contact with materials or equipment which may cause damage.

Equipment installed outdoors or in corrosive atmospheres must be protected from corrosion by the use of:

- non-corrosive materials
- wax-coated components
- factory painted components

Equipment must also be protected from mechanical and physical impact by:

- shields or guards
- building configurations or location

1910.164(e)(1) The employer shall assure that fire detection systems installed for the purpose of actuating fire extinguishment or suppression systems shall be designed to operate in time to control or extinguish a fire.

1910.164(e)(2) The employer shall assure that fire detection systems installed for the purpose of employee alarm and evacuation be designed and installed to provide a warning for emergency action and safe escape of employees.

1910.163(e)(3) The employer **shall not delay alarms** or devices initiated by fire detector actuation for **more than 30 seconds** unless such delay is necessary for the immediate safety of employees. When such delay is necessary, it shall be addressed in an emergency action plan meeting the requirements of 1910.38.

NOTE: Employers may want a delay to give time to:

- **shut down hazardous operations**
- **get evacuation monitors in positions**
- **prepare for evacuation**

These reasons would be acceptable, *if* they actually improve employee safety.

Employers may also want a delay to:

- **avoid the cost of discharging a fire suppression system**
- **avoid disrupting production**

This is acceptable *only* up to 30 seconds. A longer delay is not allowed by the standard.

1910.164(f)

The employer shall assure that the number, spacing and location of fire detectors is based upon design data obtained from field experience, or tests, engineering surveys, the manufacturer's recommendations, or a recognized testing laboratory listing. This information can also be obtained from the approved listing for detectors or NFPA standards. It can also be obtained from fire protection engineers or consultants or manufacturers of equipment who have access to approval listing and design methods.

NOTE: Spacing of fire detectors is a complex subject. Each type and model of detector has its own spacing requirements, based on testing laboratory data, manufacturer's recommendations, or approval lab listings.

Heat detector spacing **guidelines**:

- 15 to 20 feet apart
- based on actual fire tests

In the fire tests, the time of operation of automatic sprinklers is compared to time of operation of the detectors.

- heat detector must operate before the sprinkler.

For smoke detectors, **guidelines** spacings are 30 feet.

U.L. tests detectors on a smooth ceiling, without obstructions. Adjustments must be made for other ceiling configurations.

Detectors should be mounted:

- ceiling preferred
- wall acceptable
- not within 6 inches of intersection between ceiling and wall

Ceiling height becomes critical when it exceeds 16 feet.

For ceiling heights over 30 feet, detectors are generally needed at two levels:

- one-half at the ceiling
- other half 3 feet below

Surveys by a fire protection engineer or consultant, or a qualified manufacturer, are the only ways to determine whether spacing is appropriate.

1910.165 - EMPLOYEE ALARM SYSTEMS

1910.165(a)(1) This section applies to all emergency employee alarms installed to meet a particular OSH standard. This section does not apply to those discharge or supervisory alarms required on various fixed extinguishing systems or to supervisory alarms on fire suppression, alarm or detection systems unless they are intended to be employee alarm systems.

The following is a list of standards (not intended to be all-inclusive) which refer to employee alarm systems:

1910.37(n)
1910.38(a)(3)(i)
1910.160(c)(3)
1910.161(b)(3)
1910.162(b)(3)

NOTE: This section is intended too apply to employee alarm systems used for all types of employee emergencies except those which occur so quickly and at such a rapid rate (e.g., explosion) that any action by the employee is extremely limited following detection.

In small workplaces of 10 or less employees the alarm system can be by direct voice communication (shouting) where any one individual can quickly alert all other employees. Radio may be used to transmit alarms from remote workplaces where telephone service is not available, provided that radio messages will be monitored by emergency services, such as fire, police or others, or insure alarms are transmitted and received.

All pre-discharge employee alarms installed to meet a particular OSH standard shall meet the requirements of 1910.165(b)(1) through (b)(4), (c), and (d)(1).

1910.165(b)(1) The employee alarm system shall provide warning for necessary emergency action as called for in the emergency action plan, or for reaction time for safe escape of employees from the workplace or the immediate work area, or both.

Alarm systems include three components:

- signal devices to alert occupants
- alarm initiating devices
- control equipment

1910.165(b)(2) The employee alarm shall be capable of being perceived above ambient noise or light levels by all employees in the affected portions of the workplace. Tactile devices may be used to alert those employees who would not otherwise be able to recognize the audible or visual alarm. **NOTE: In recognition of physically impaired individuals, OSH is**

accepting various methods of giving alarm signals. For example, visual, tactile or audible alarm signals are acceptable methods of giving alarms to employees. Flashing lights or vibrating devices can be used in areas where the employer has hired employees with hearing or vision impairments. Vibrating devices, air fans, or other tactile devices can be used where visually and hearing impaired employees work. Employers are cautioned that certain frequencies of flashing lights have been claimed to initiate epileptic seizures in some employees and that this fact should be considered when selecting an alarm device. Two way radio communications would be most appropriate for transmitting emergency alarms in such workplaces which may be remote or where telephones may not be available.

1910.165(b)(3) The employee alarm shall be distinctive and recognizable as a signal to evacuate the work area or to perform actions designated under the emergency action plan.

NOTE: Alarm signals must be perceived above normal conditions in the workplace. While not a specific standard, it is generally acceptable that audible alarms producing sound levels 5 to 15 dBA above ambient sound level are adequate; however, the sound levels must not exceed the safe level for employees exposure.

Alarms should be readily recognizable as such, and must be distinctive from other common sounds, such as:

- elevator call bells
- lunch or quitting time bells
- truck back-up alarms

1910.165(b)(4) The employer shall explain to each employee the preferred means of reporting emergencies, such a manual pull box alarms, public address systems, radio or telephones. The employer shall post emergency telephone numbers near telephones, or employee notice boards, and other conspicuous locations when telephones serve as a means of reporting emergencies. Where a communication system also serves as the employee alarm system, all emergency messages shall have priority over all nonemergency messages.

1910.165(b)(5) The employer shall establish procedures for sounding emergency alarms in the workplace. For those employers with 10 or fewer employees in a particular workplace, direct voice communication is an acceptable procedure for the alarm provided all employees can hear the alarm. Such workplaces need to have a back-up system.

NOTE: Employee alarms may require different means of reporting, depending on the workplace involved. For example, in small workplaces, a simple shout throughout the workplace may be sufficient to warn employees of a fire or other emergency. In larger workplaces, more sophisticated equipment is necessary so that entire

plants or high-rise buildings are not evacuated for one small emergency. In remote areas, such as pumping plants, radio communication with a central base station may be necessary. The goal of this standard is to assure that all employees who need to know that an emergency exists can be notified of the emergency. The method of transmitting the alarm should reflect the situation found at the workplace.

Personal radio transmitters, worn by an individual, can be used where the individual may be working such as in a remote location. Such personal radio transmitters shall send a distinct signal and should clearly indicate who is having an emergency, the location, and the nature of the emergency. All radio transmitters need a feedback system to assure that the emergency alarm is sent to the people who can provide assistance.

For multi-story buildings or single story buildings with interior walls for subdivisions, the more traditional alarm systems are recommended. Supervised telephone or manual fire alarm or pull box stations with paging systems to transmit messages throughout the building is the recommended alarm system. The alarm box stations should be available within a travel distance of 200 feet (61 m). Water flow detection on a sprinkler system, fire detection systems (guard's supervisory station) or tour signal (watchman's service) or other related systems may be part of the overall system. The paging system may be used for nonemergency operations provided the emergency messages and uses will have precedence over all other uses of the system.

1910.165(c)(1) The employer shall assure that all devices, components, combinations of devices or systems constructed and installed to comply with this standard are approved. Steam whistles, air horns, strobe lights or similar lighting devices, or tactile devices meeting the requirements of this section are considered to meet this requirement for approval.

1910.165(c)(2) The employer shall assure that all employee alarm systems are restored to normal operating condition as promptly as possible after each test or alarm. Spare alarm devices and components subject to wear or destruction shall be available in sufficient quantities and locations for prompt restoration of the system.

1910.165(d)(1) The employer shall assure that all employee alarm systems are maintained in operating condition except when undergoing repairs or maintenance.

1910.165(d)(2) The employer shall assure that a test of the reliability and adequacy of non-supervised employee alarm systems is made every two months. A different actuation device shall be used in each test of a multi-actuation device system so that no individual device is used for two consecutive tests.

1910.165(d)(3) The employer shall maintain or replace power supplies as often as is necessary to assure the fully operational condition. Back-up means of alarm, such as employee runners or telephones, shall be provided when

systems are out of service.

1910.165(d)(4) The employer shall assure that employee alarm circuitry installed after January 1, 1981, which is capable of being supervised is supervised and that it will provide positive notification to assigned personnel whenever a deficiency exists in the system. The employer shall assure that all supervised employee alarm systems are tested at least annually for reliability and adequacy.

NOTE: Certain devices, such as air horns, cannot be supervised with present technology but can be monitored by inspection and testing. As multi-device systems are tested, different manual actuation devices should be used each time, so that the entire system eventually gets tested.

1910.165(d)(5) The employer shall assure that the servicing, maintenance and testing of employee alarms are done by persons trained in the designed operation and functions necessary for reliable and safe operation of the system.

1910.165(e) Manual operation. The employer shall assure that manually operated actuation devices for use in conjunction with employee alarms are unobstructed, conspicuous and readily accessible.

NOTE: Evaluation of Employee Alarm Systems

If workplace is very small

- **all employees likely to be aware of a fire, or**
- **any one employee capable of alerting all others without mechanical assistance**

then an alarm system would *not* be needed.

If alarm system is needed, it may range from

- **simple alarm device controlled by manual pull station, to**
- **complex system with a variety of sounding devices and/or lights, and control equipment with voice announcing capabilities**

The control equipment consists of a control panel and logic circuits which determine how the system is to function.

The control panel shows system status and allows for operator action and contains any or all of the following items:

- **Visual indicators (lamps of system status)**
- **Visual Plain English Display of System Status**

- **Special Panel Tones for System Status**
  - **Reset Switches**
  - **Test Switches**
  - **Selection Switches for Areas of Alarm Signals**
  - **Selection Switches of Various Emergency Signaling Tones**
  - **Voice Communication Devices (Microphone)**
  - **Paper Printout Machines for Permanent Copy**
  - **Requires Access Key for Authorized Personnel Only**

The control logic circuits accept the signals from the various heat, smoke, and flame detectors, etc., and determine which and what type of signals are to be sounded on the alarm system. The control logic circuit is always checking itself (supervision) and if the system is not operating properly it will sound a special trouble signal within the control panel. This alerts trained personnel of system problems.

The complexity of the system should be tailored to the complexity of the workplace.